

Figure 2-1 Key Steps in DCRBCA Process

* See Figure 5-1 for step by step description

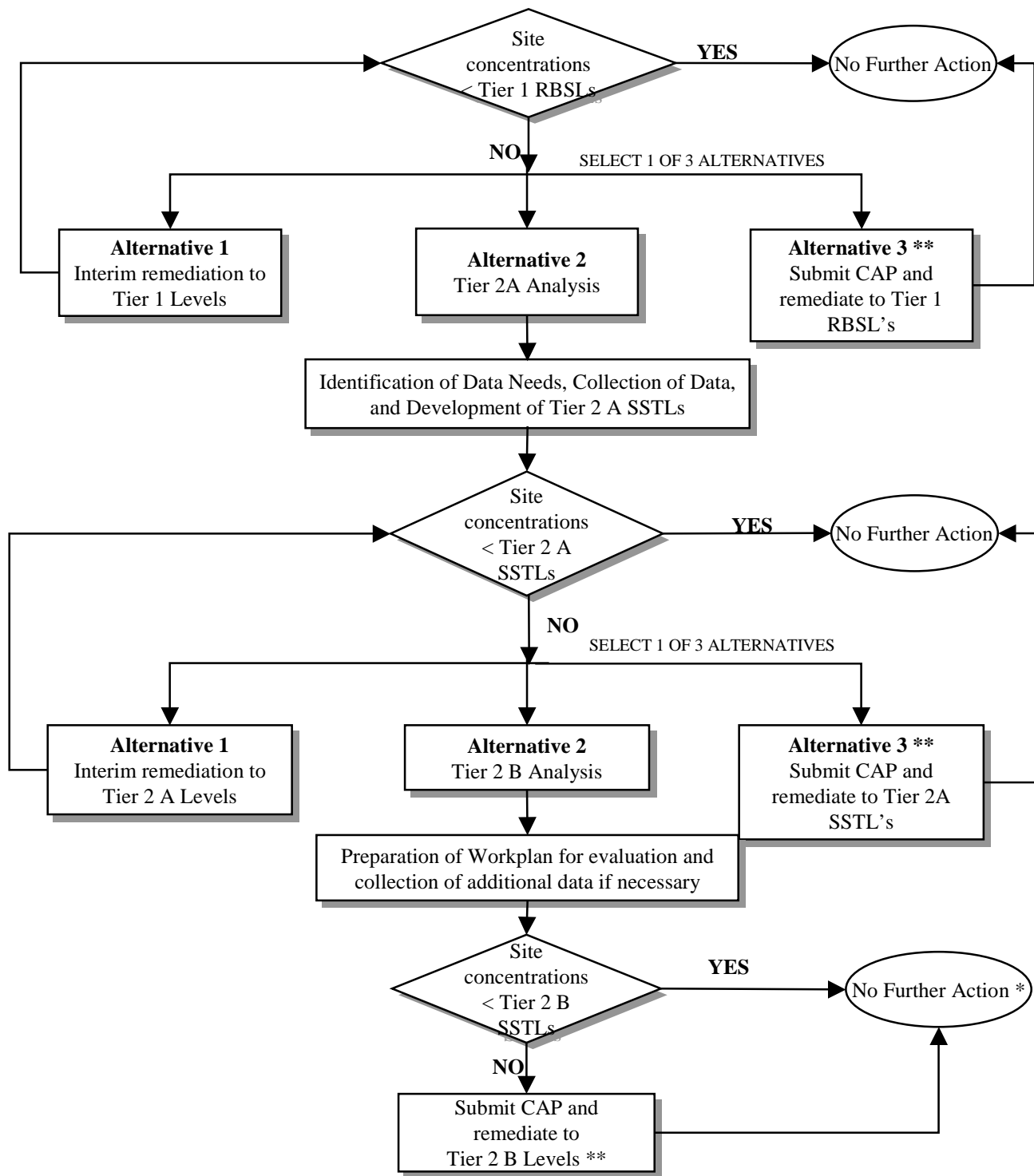


Figure 5-1: SELECTION AND DEVELOPMENT OF TARGET LEVELS IN DCRBCA PROCESS

* Requires the Groundwater plume to be stable or decreasing, no free product, and no nuisance conditions

** Requires Preparation of a corrective action plan

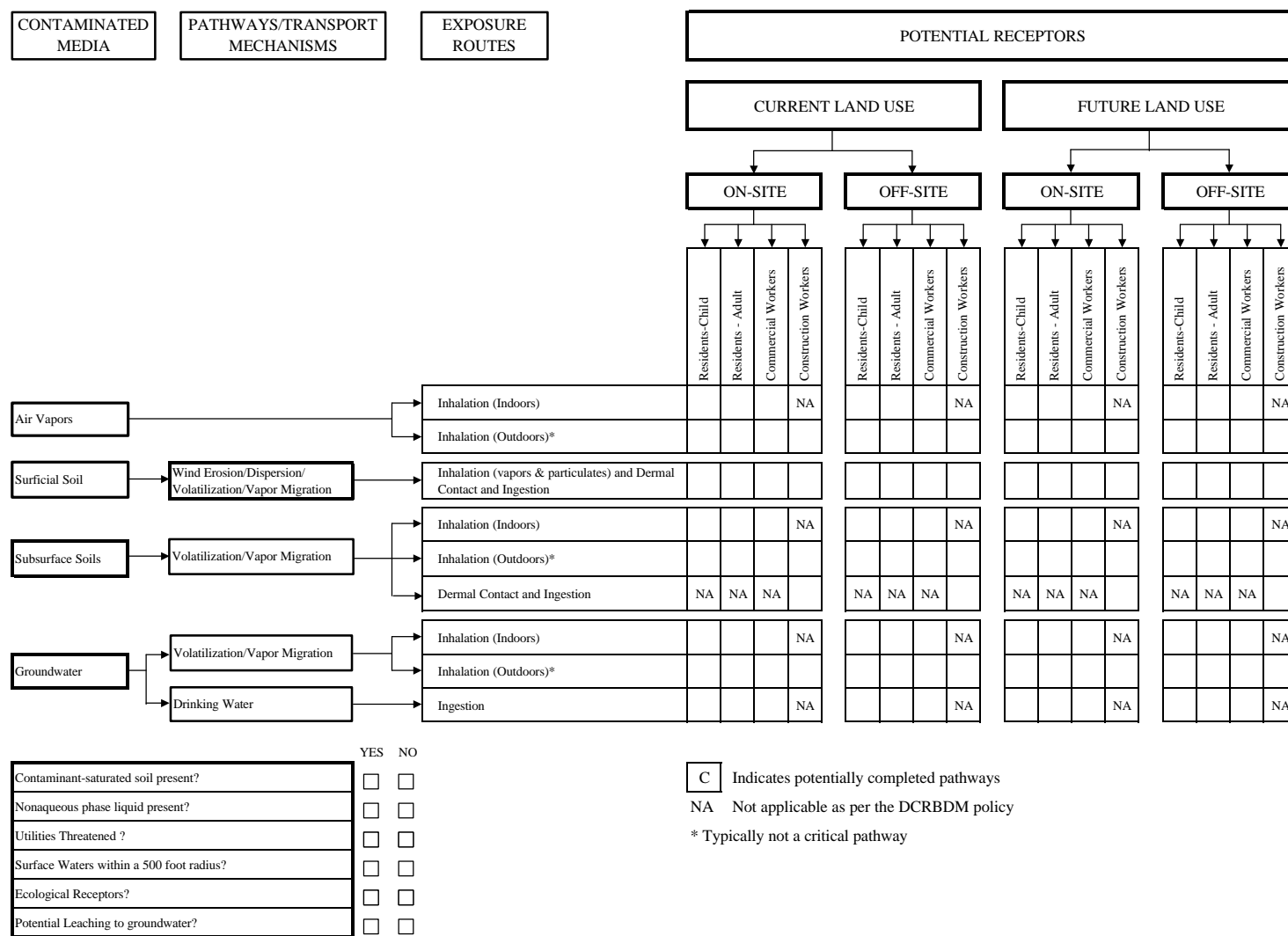
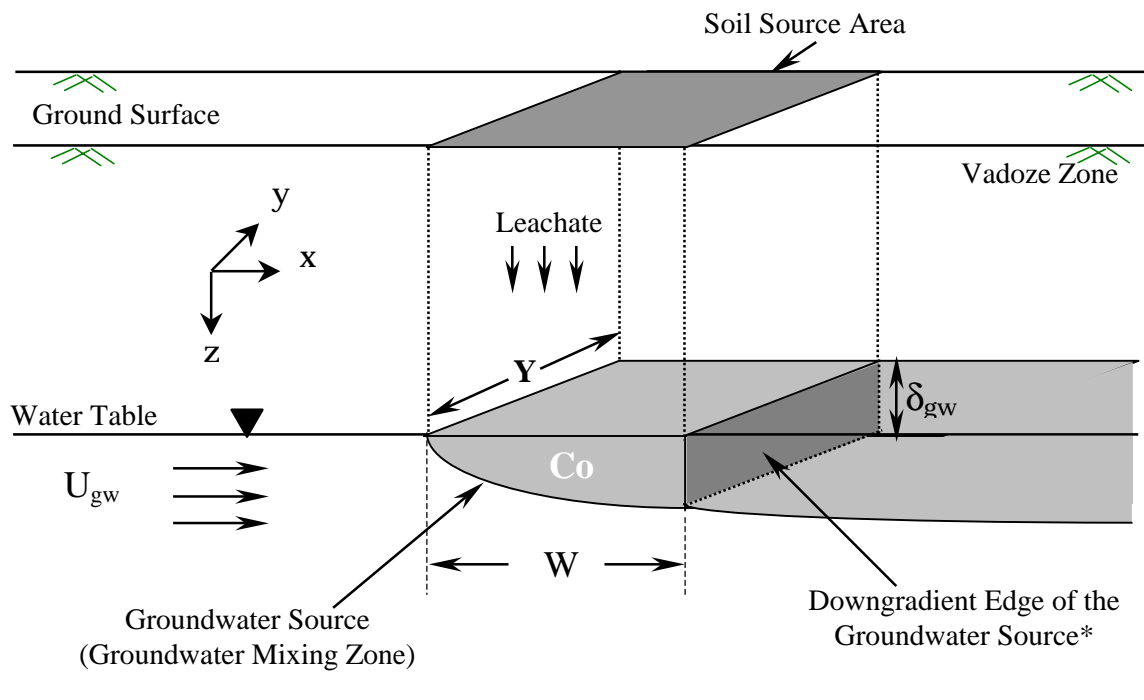
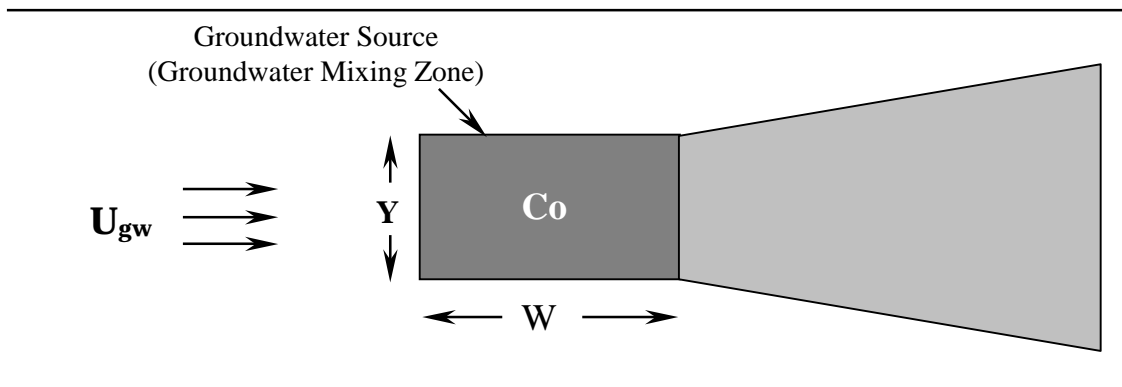


Figure 5-2
Graphical Display of a Site Conceptual Exposure Scenario
(For Illustration Only)



SECTION



PLAN

U_{gw} = Groundwater velocity
 D_{gw} = Thickness of the mixing zone
 C_o = Source concentration

Note:

Assumes only vertical leaching, i.e., there is no horizontal spreading in the unsaturated zone.

Figure 5-3
Areal Dimensions of Soil Source

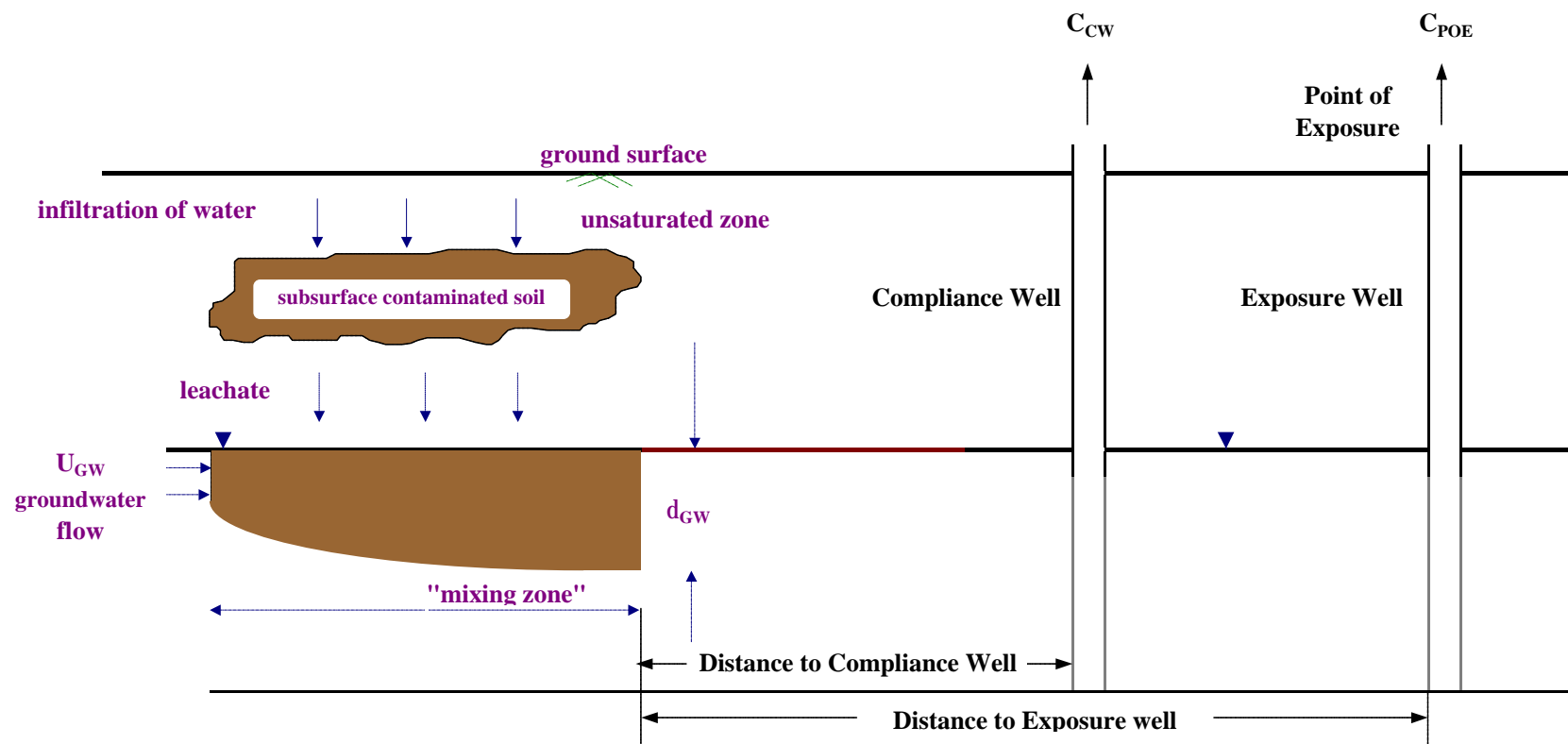


Figure 5-4
Schematic of the Source, Compliance Well, and Exposure Well

Table 2-1: Reporting Requirements Under the DCRBCA Process

Step No.	Description	Deliverables
1	Failure of Release Detection System	If release detection is not repaired within 45 days, report to Division within 24 hours after the expiration of 45 days.
2	Spill Reports	Spills exceeding 25 gallons or those not cleaned within 24 hours must be reported within 24 hours.
3	Release Report	Notify within 24 hours of suspicion or confirmation of release.
4	Initial Site Assessment	To be submitted within 60 days after confirmation of release.
5	Free Product Removal	Free product removal report within 45 days.
6	Comprehensive Site Assessment Report	Within 60 days of submission of the Workplan.
7	Groundwater Monitoring Report	Data to be submitted within 30 days of receipt from laboratory. Semi-Annual or an Annual Comprehensive report.
8	DCRBCA Report	As requested by the Division.

Table 4-1 (Page 1 of 2)

Chemicals of Concern for Different Product Releases

Chemical	Gasoline	Diesel/ Light Fuel Oils	Kerosene Jet Fuel	Heavy Fuel Oils	Waste/ Used Oil	Analytical Methods**	
ORGANICS						Groundwater	Soil
Benzene	X	NC	NC	NC	X	8020, 8021, 8260 ¹	8020, 8021, 8260 ¹
Toluene	X	NC	NC	NC	X	8020, 8021, 8260 ¹	8020, 8021, 8260 ¹
Ethylbenzene	X	NC	NC	NC	X	8020, 8021, 8260 ¹	8020, 8021, 8260 ¹
Xylenes (total)	X	NC	NC	NC	X	8020, 8021, 8260 ¹	8020, 8021, 8260 ¹
Methyl-tert-butyl-ether (MTBE)	X	NC	NC	NC	X	8020, 8021, 8260 ¹	8020, 8021, 8260 ¹
Naphthalene	NC	X	X	X	X	8020, 8260 ¹ , 8270	8020, 8260 ¹ , 8270
TPH (GRO) C ₆ -C ₁₂ (purgeable)	X	NC	NC	NC	X	8015 Modified	8015 Modified
TPH (DRO) C ₁₀ -C ₂₀ (extractable)	NC	X	X	X	X	8015 Modified	8015 Modified
TPH (ORO) C ₂₀ -C ₂₈ (extractable)	NC	NC	X	X	X	8015 Modified	8015 Modified
TPH Fractions							
>C8-C10 Aromatics	X	X	X	NC	X	*	*
>C10-C12 Aromatics	X	X	X	NC	X	*	*
>C12-C16 Aromatics	X	X	X	NC	X	*	*
>C16-C21 Aromatics	NC	X	NC	NC	X	*	*
>C21-C35 Aromatics	NC	X	NC	X	X	*	*
C5-C6	NC	X	NC	NC	X	*	*
>C6-C8 Aliphatics	X	NC	X	NC	X	*	*
>C8-C10 Aliphatics	X	X	X	NC	X	*	*
>C10-C12 Aliphatics	X	X	X	NC	X	*	*
>C12-C16 Aliphatics	NC	X	X	NC	X	*	*
>C16-C35 Aliphatics	NC	X	NC	X	X	*	*

See footnotes on Page 2 of 2

Table 4-1 (Page 2 of 2)

Chemicals of Concern for Different Product Releases

Note: X Chemical of concern to be analyzed

NC Not a chemical of concern

1 For 8260 for <200 ppb of analyte, use extraction Method 5035 for soil, promulgated June 1997.

* Contact laboratory for an appropriate GC/FID method. Available methods include the Massachusetts Method and the TPH Criteria Working Group Method. Fractionation is recommended only for Tier 2B evaluation.

** For any other methods, please contact the DC Underground Storage Tank Division for approval.

Sources:

- DC Underground Storage Tank Division
- U. S. Environmental Protection Agency, November 1986, *Test Methods for Evaluating Solid Waste*, SW-846, Third Edition. Office of Solid Waste and Emergency Response, Washington D.C.
- U.S. Environmental Protection Agency, March 1983, *Methods for Chemical Analysis of Water and Wastes*, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45263.
- Methods Information Communication Exchange, Office of Solid Waste, (703) 821-4690.
- U.S. Environmental Protection Agency, July 1982, *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, EPA-600/4-82-057. Environmental Monitoring and Support Laboratory, Cincinnati, OH 45263.

TABLE 5-1
EXAMPLE OF TABULAR FORMAT FOR SITE CONCEPTUAL EXPOSURE
SCENARIO

Potentially Exposed Population/Land Use	Pathway, Medium, and Route of Exposure	Pathway Selected for Evaluation?	Reason for Selection or Non-Selection
On-site Commercial Worker	Indoor inhalation of vapors from surficial soil	No	Surficial soil under the on-site building is not impacted. Therefore, there will not be any vapor emission into the on-site building from surficial soil.
	Inhalation (outdoor) of particulates and dermal contact and ingestion of surficial soil	No	Although on-site surficial soil (away from the building) is impacted, the site is paved. Therefore, this pathway is incomplete.
	Leaching to groundwater from surficial soil	Yes	Although the site is paved, infiltration through the pavement can leach chemicals into groundwater.
	Indoor inhalation of vapor emissions from subsurface soil	No	Source area is away from the building and subsurface soil under the building is not impacted. Therefore, there will not be any vapor emission into the on-site building from subsurface soil.
	Dermal contact and ingestion with subsurface soil	No	Since the site is paved, it is unlikely that a commercial worker will come in contact with impacted subsurface soil.
	Leaching to groundwater from subsurface soil	Yes	Although the site is paved, infiltration through the pavement can leach chemicals into groundwater.
	Indoor inhalation of vapor emissions from groundwater	Yes	Groundwater plume is under the building. Therefore, it is possible that vapors evolving from groundwater plume would enter the on-site building through cracks in the foundation.
	Ingestion of groundwater	No	No drinking water well on-site. Water to the area is supplied by the City.
Off-site Commercial Worker	Indoor inhalation of vapors from surficial soil	No	Off-site soil (surficial and subsurface) is not impacted. Therefore, there will not be any vapor emissions from off-site soil.
	Inhalation (outdoor) particulates and dermal contact and ingestion of surficial soil	No	Off-site soil (surficial and subsurface) is not impacted. Therefore, there will not be any vapor emissions from off-site soil.
	Leaching to groundwater from surficial soil	No	Off-site soil (surficial and subsurface) is not impacted. Therefore, there will not be any leaching of chemicals into groundwater.
	Indoor inhalation of vapor emissions from subsurface soil	No	Off-site soil (surficial and subsurface) is not impacted. Therefore, there will not be any vapor emissions from off-site soil.
	Dermal contact and ingestion of subsurface soil	No	Off-site soil (surficial and subsurface) is not impacted. Therefore, there will not be any exposure to chemicals through ingestion or dermal contact of subsurface soil.
	Leaching to groundwater from subsurface soil	No	Off-site soil (surficial and subsurface) is not impacted. Therefore, there will not be any leaching of chemicals into groundwater.
	Indoor inhalation of vapor emissions from groundwater	Yes	Groundwater plume has migrated under off-site buildings. Therefore, it is possible that vapors evolving from groundwater plume would enter the off-site buildings through cracks in the foundation.
	Ingestion of groundwater	No	No drinking water well in the vicinity of the site. Water to the area is supplied by the City.

TABLE 5-2
PHYSICAL AND CHEMICAL PROPERTIES OF CONTAMINANTS OF CONCERN

Chemical	Mol. Wt.	Pure Product Solubility (S)	Henry's Constant (H)	K _{oc}	Diffusion Coefficient in Air (D ^a)	Diffusion Coefficient in Water (D ^w)
ORGANICS	[g/mole]	[mg/L]	[(mg/cm ³)-a/ (mg/cm ³)-w]	[cm ³ -water/g-C]	[cm ² /s]	[cm ² /s]
Benzene	78.11	1.75E+03	2.28E-01	6.61E+01	9.30E-02	1.10E-05
Toluene	92.1	5.26E+02	2.72E-01	1.35E+02	8.50E-02	9.40E-06
Ethylbenzene	106.2	1.69E+02	3.23E-01	6.76E+02	7.60E-02	8.50E-06
Xylenes (mixed)	106.2	1.98E+02	2.86E-01	6.92E+02	7.20E-02	8.50E-06
Methyl-tert-butyl-ether (MTBE)	88.2	4.80E+04	2.44E-02	1.41E+01	1.02E-01	1.05E-05
Naphthalenes	128	3.10E+01	1.98E-02	1.54E+05	7.20E-02	9.40E-06
TPH						
TPH-GRO	NA	NA	NA	NA	NA	NA
TPH-DRO	NA	NA	NA	NA	NA	NA
TPH-ORO	NA	NA	NA	NA	NA	NA
ALIPHATICS**						
>C6-C8	100	5.4E+00	5.0E+01	3.981E+03	1.01E-01	1.00E-05
>C8-C10	130	4.3E-01	8.0E+01	3.162E+04	1.01E-01	1.00E-05
>C10-C12	160	3.4E-02	1.2E+02	2.511E+05	3.07E-02	8.16E-06
>C12-C16	200	7.6E-04	5.2E+02	5.011E+06	3.06E-02	7.30E-06
>C16-C35	270	1.3E-06	4.9E+03	6.309E+08	2.63E-02	6.28E-06
AROMATICS**						
>C8-C10	120	6.5E+01	4.8E-01	1.584E+03	7.14E-02	7.99E-06
>C10-C12	130	2.5E+01	1.4E-01	2.512E+03	3.79E-02	9.06E-06
>C12-C16	150	5.8E+00	5.3E-02	5.012E+03	3.53E-02	8.43E-06
>C16-C21	190	6.5E-01	1.3E-02	1.584E+04	3.14E-02	7.49E-06
>C21-C35	240	6.66E-03	6.7E-04	1.258E+05	5.12E-02	5.94E-06

Sources: USEPA, May 1996. *Soil Screening Guidance Technical Background Document*. EPA/540/R-95/128.
Texas Natural Resources Conservation Commission, Texas Risk Reduction Program, 350TAC, September 1999.
ASTM Standard E1739-1995, *Standard Guide for Risk-Based Corrective Action at Petroleum Release Sites*.

Diffusion coefficients for TPH fractions were calculated based on molecular weights.

** Required only for Tier 2B evaluation

Table 5-3 (Page 1 of 2)

Toxicity Properties of Contaminants of Concern

CHEMICAL	Slope Factor [kg-d/mg]				Reference Dose [mg/kg-d]			
	Oral (SF _o)	Source	Inhalation (SF _i)	Source	Oral (RfD _o)	Source	Inhalation (RfD _i)	Source
ORGANICS								
Benzene	0.055	1	0.029	1	0.003	1	0.0017	1
Toluene	NA	NA	NA	NA	0.20	1	0.114	1
Ethylbenzene	NA	NA	NA	NA	0.10	1	0.29	1
Xylenes (Total)	NA	NA	NA	NA	2.00	1	0.086	*
Methyl-tert-Butyl-Ether	NA	NA	NA	NA	0.857	**	0.857	1
Naphthalene	NA	NA	NA	NA	0.02	1	0.000943	1
TPH-GRO	NA	NA	NA	NA	NA	NA	NA	NA
TPH-DRO	NA	NA	NA	NA	NA	NA	NA	NA
TPH-ORO	NA	NA	NA	NA	NA	NA	NA	NA
>C6-C8 Aliphatics***	NA	NA	NA	NA	5.0	2	1.5143	2
>C8-C10 Aliphatics***	NA	NA	NA	NA	0.1	2	0.0857	2
>C10-C12 Aliphatics***	NA	NA	NA	NA	0.1	2	0.0857	2
>C12-C16 Aliphatics***	NA	NA	NA	NA	0.1	2	0.8571	2
>C16-C35 Aliphatics***	NA	NA	NA	NA	2.0	2	NA	2
>C8-C10 Aromatics***	NA	NA	NA	NA	0.04	2	0.0571	2
>C10-C12 Aromatics***	NA	NA	NA	NA	0.04	2	0.0571	2
>C12-C16 Aromatics***	NA	NA	NA	NA	0.04	2	0.0571	2
>C16-C21 Aromatics***	NA	NA	NA	NA	0.03	2	NA	2
>C21-C35 Aromatics***	NA	NA	NA	NA	0.03	2	NA	2

NOTES:

NA Not Applicable

* September 1997. Still awaiting best values for these parameters. In the interim, the smaller values are presented in the DRAFT and these values will be revised as more information is available.

**Oral RfD set equal to inhalation RfD.

*** Required only for Tier 2B evaluations

SOURCES:

1. US EPA Region III, RBC Table 10/5/2000.
2. See Appendix D.

Table 5-4 (Page 1 of 2)

Tier 1 and 2A Default Exposure Factors

EXPOSURE PARAMETER	SYMBOL	UNITS	DEFAULT VALUE	REFERENCE
Averaging Time - Carcinogen	ATc	years	70	EPA, 1989
Averaging Time - Noncarcinogen (equals exposure duration):	ATn	years	Receptor dependent	EPA, 1989
Body Weight:				
Adult Receptors	BW	kg	70	EPA, 1989
Child Receptors	BW	kg	15	EPA, 1989
Exposure Duration:				
Resident Child	ED	years	6	EPA, 1989
Resident Adult	ED	years	30	EPA, 1989
Commercial Worker	ED	years	25	EPA, 1989
Construction Worker	ED	years	1	Professional Judgement
Exposure Frequency:				
Residents	EF	days/yr	350	EPA, 1989
Commercial Worker	EF	days/yr	250	EPA, 1989
Construction Worker	EF	days/yr	90	Professional Judgement
Soil Ingestion Rate:				
Resident Child	IR soil	mg/day	200	EPA, 1989
Resident Adult	IR soil	mg/day	100	EPA, 1989
Commercial Worker	IR soil	mg/day	50	EPA, 1989
Construction Worker	IR soil	mg/day	480	Hawley, 1985
Daily Water Ingestion Rate:				
Resident Adult	IRw	L/day	2	EPA, 1989
Hourly Indoor Inhalation Rate:				
Resident Child	IRai	m ³ /hr	0.417	EPA, 1997
Resident Adult	IRai	m ³ /hr	0.633	EPA, 1997
Commercial Worker	IRai	m ³ /hr	1.5	EPA, 1997
Exposure Time for Indoor Inhalation:				
Resident Child	ETin	hr/day	18	Professional Judgement
Resident Adult	ETin	hr/day	18	Professional Judgement
Commercial	ETin	hr/day	10	Professional Judgement
Hourly Outdoor Inhalation Rate:				
Resident Child	IRao	m ³ /hr	1	EPA, 1997
Resident Adult	IRao	m ³ /hr	1.5	EPA, 1997
Commercial Worker	IRao	m ³ /hr	1.5	EPA, 1997
Construction Worker	IRao	m ³ /hr	1.5	EPA, 1997

TABLE 5-4 (Page 2 of 2)
Tier 1 and 2 Default Exposure Factors

EXPOSURE PARAMETER	SYMBOL	UNITS	DEFAULT VALUE	REFERENCE
Exposure Time for Outdoor Inhalation:				
Resident Child and Adult	ETout	hr/day	10	Professional Judgement
Commercial Worker	ETout	hr/day	10	Professional Judgement
Construction Worker	ETout	hr/day	10	Professional Judgement
Soil skin adherence factor	M	mg/cm ²	0.15	Kissel et al., 1996, Holmes et al., 1996
Oral relative absorption factor	RAFo	---	1	ASTM, 1995
Dermal relative absorption factor:				
Volatiles	RAF _d	---	0.5	ASTM, 1995
PAHs	RAF _d	---	0.05	ASTM, 1995
TPH				
C5 - C6 (Aliphatics)	RAF _d	---	0.1	TRRP, 1999
>C6 - C8 (Aliphatics)	RAF _d	---	0.1	TRRP, 1999
>C8 - C10 (Aliphatics)	RAF _d	---	0.1	TRRP, 1999
>C10 - C12 (Aliphatics)	RAF _d	---	0.1	TRRP, 1999
>C12 - C16 (Aliphatics)	RAF _d	---	0.1	TRRP, 1999
>C16 - C35 (Aliphatics)	RAF _d	---	0.1	TRRP, 1999
>C8 - C10 (Aromatics)	RAF _d	---	0.1	TRRP, 1999
>C10 - C12 (Aromatics)	RAF _d	---	0.1	TRRP, 1999
>C12 - C16 (Aromatics)	RAF _d	---	0.1	TRRP, 1999
>C16 - C21 (Aromatics)	RAF _d	---	0.13	TRRP, 1999
>C21 - C35 (Aromatics)	RAF _d	---	0.13	TRRP, 1999
Skin surface area for dermal contact with soil:				
Adult receptors	SA	cm ² /d	5000	EPA, 1997
Child receptors	SA	cm ² /d	2500	EPA, 1997
Construction Worker	SA	cm ² /d	7250	EPA, 1992
Hazard Quotient for individual constituents/routes	THQ	---	1	
Individual Excess Lifetime Cancer Risk for constituents/routes	TR	---	1x10 ⁻⁶	

Sources

1. US EPA. 1989. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Interim Final. Washington D. C., Office of Emergency and Remedial Response. EPA/540/1-89/002.
2. Hawley, J.K. 1985. Assessment of Health Risk from Exposure to Contaminated Soil, Risk Analysis 5:289-302.
3. Exposure Factors Handbook, Volume I. August 1997. U.S. EPA, Washington D.C. EPA/600/P-95/002Fa.
4. Holmes, K.K., Kissel, J.C., and Richter, K.Y. 1996. Investigation of the Influence of Oil on Soil Adherence to Journal of Soil Contamination, 5(4):301-308.
5. Kissel, J.C., Richter, K.Y., and Fenske, R. 1996. Field Measurements of Dermal Soil Loading Attributable to Various Activities: Implications of Exposure Assessment, Risk Analysis, 16(1): 116-125.
6. American Society for Testing and Materials, 1995. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites, Designation: E1739-95. ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428.
7. US EPA. 1992. Dermal Exposure Assessment: Principles and Applications, Washington D. C., Office of Research and Development, Office of Health and Environmental Assessment/OHEA. EPA/600/8-9-91.
8. Texas Natural Resource Conservation Commission, September 1999. Texas Risk Reduction Program, Chapter 350.

Table 5-5 (Page 1 of 2)
Tier 1 Default Fate and Transport Parameters

Parameter	Symbol	Unit	Tier 1 Values
SOIL PARAMETERS:			
Length of Soil Source Area Parallel to Wind Direction	W_a	cm	1500
Depth to Subsurface Soil Sources	L_s	cm	30.48
Lower Depth of Surficial Soil Zone	d	cm	30.48
Thickness of Capillary Fringe	h_{cap}	cm	5
Thickness of Vadose Zone*	h_v	cm	295
Dry Soil Bulk Density	ρ_s	g/cm ³	1.8
Fractional Organic Carbon Content in the Vadose Zone	foc	g-C/g-soil	0.01
Total Porosity in the Vadose Zone	θ_T	cm ³ /cm ³ -soil	0.3
Volumetric Water Content in Capillary Fringe*	θ_{wcap}	cm ³ /cm ³	0.27
Volumetric Water Content in Vadose Zone	θ_{ws}	cm ³ /cm ³	0.2
Volumetric Water Content in Foundation or Wall Cracks	θ_{wcrack}	cm ³ /cm ³	0.2
Volumetric Air Content in Capillary Fringe*	θ_{acap}	cm ³ /cm ³	0.03
Volumetric Air Content in Vadose Zone*	θ_{as}	cm ³ /cm ³	0.1
Volumetric Air Content in Foundation/Wall Cracks*	θ_{acrack}	cm ³ /cm ³	0.1
GROUNDWATER PARAMETERS:			
Depth to Groundwater	L_{gw}	cm	300
Length of Groundwater Source Area Parallel to Wind Direction	W_{ga}	cm	1500
Width of GW Source Perpendicular to the GW Flow Direction	Y	cm	1500
Length of the GW Source Parallel to the GW Flow Direction	W	cm	1500
Total Porosity in the Saturated Zone	θ_{TS}	cm ³ /cm ³ -soil	0.3
Saturated Zone Dry Soil Bulk Density	ρ_{ss}	g/cm ³	1.8
Fractional Organic Carbon Content in the Saturated Zone	foc _s	g/g	0.01
Groundwater Mixing Zone Thickness	d_{gw}	cm	200
Hydraulic Conductivity in the Saturated Zone	K	cm/year	76000
Hydraulic Gradient in the Saturated Zone	i	--	0.004
Groundwater Darcy Velocity*	U_{gw}	cm/year	304
Infiltration Rate	I	cm/year	14
STREAM PARAMETERS:			
Stream Flow Rate Upstream of the Point of Groundwater Discharge	Q_{sw}	ft ³ /day	Variable
Impacted Groundwater Discharge into the Stream	Q_{gw}	ft ³ /day	Calculated
COCs Concentration Upstream of the Groundwater Plume Discharge	C_{su}	mg/L	0
AMBIENT AIR PARAMETERS:			
Breathing Zone Height	δ_a	cm	200
Wind Speed within the Breathing Zone	U_a	cm/s	225
ENCLOSED SPACE PARAMETERS:			
Enclosed Space Air Exchange Rate:			
Residential	ER	1/sec	0.00014
Commercial/Construction Worker	ER	1/sec	0.00023
Enclosed Space Volume/Infiltration Area Ratio:			
Residential	L_B	cm	200
Commercial/Construction Worker	L_B	cm	300

Table 5-5 (Page 2 of 2)
Tier 1 Default Fate and Transport Parameters

Parameter	Symbol	Unit	Tier 1 Values
ENCLOSED SPACE PARAMETERS (Continued):			
Enclosed Space Foundation or Wall Thickness			
Residential	Lcrack	cm	15
Commercial/Construction Worker	Lcrack	cm	15
Areal Fraction of Cracks in Foundation/Walls			
Residential	h	cm ² /cm ²	0.01
Commercial/Construction Worker	h	cm ² /cm ²	0.01
PARTICULATE EMISSION RATE:			
Residential and Commercial	Pe	g/cm ² sec	6.90E-14
Construction Worker	Pe	g/cm ² sec	6.90E-09
AVERAGING TIME FOR VAPOR FLUX:			
Resident Child	τ	sec	1.89E+08
Resident Adult	τ	sec	9.46E+08
Commercial Worker	τ	sec	7.88E+08
Construction Worker	τ	sec	3.15E+07
GROUNDWATER RESOURCE PROTECTION PARAMETERS:			
Distance from the Downgradient Edge of the Groundwater Source to the Point of Exposure	Xpoe	ft	Variable
Longitudinal Dispersivity*	α_x	ft	Xpoe/10
Transverse Dispersivity*	α_y	ft	Xpoe/30
Vertical Dispersivity*	α_z	ft	Xpoe/200
Distance from the Downgradient Edge of the Groundwater Source to the Point of Compliance	Xpoc	ft	Variable
Longitudinal Dispersivity*	α_x	ft	Xpoc/10
Transverse Dispersivity*	α_y	ft	Xpoc/30
Vertical Dispersivity*	α_z	ft	Xpoc/200
STREAM PROTECTION PARAMETERS:			
Distance from the Downgradient Edge of the Groundwater Source to the Stream	Xs	ft	Variable
Longitudinal Dispersivity*	α_x	ft	Xs/10
Transverse Dispersivity*	α_y	ft	Xs/30
Vertical Dispersivity*	α_z	ft	Xs/200
Distance from the Downgradient Edge of the Groundwater Source to the Point of Compliance	Xspoc	ft	Variable
Longitudinal Dispersivity*	α_x	ft	Xspoc/10
Transverse Dispersivity*	α_y	ft	Xspoc/30
Vertical Dispersivity*	α_z	ft	Xspoc/200

Note:

* = Calculated value

Table 5-6
Groundwater and Surface Water Standards at the Point of Exposure

CHEMICAL	GROUNDWATER	SURFACE WATER	
	[mg/L]		[mg/L]
ORGANICS			
Benzene	0.005		0.005
Toluene	1.0		1.0
Ethylbenzene	0.7		0.7
Xylenes (mixed)	10.0		10.0
Methyl-tert-butyl-ether (MTBE)	0.05		0.05
Naphthalene	0.73		0.73
TPH FRACTIONS			
TPH-GRO	7.3		7.3
TPH-DRO	3.57		3.57
TPH-ORO	0.0067	#	0.0067 #
C5 - C6 (Aliphatics)	N/A		N/A
>C6 - C8 (Aliphatics)	5.40	#	5.40 #
>C8 - C10 (Aliphatics)	0.430	#	0.430 #
>C10 - C12 (Aliphatics)	0.034	#	0.03 #
>C12 - C16 (Aliphatics)	0.00076	#	0.00076 #
>C16 - C35 (Aliphatics)	0.0000013	#	0.0000013 #
>C8 - C10 (Aromatics)	1.46		1.46
>C10 - C12 (Aromatics)	1.460		1.4600
>C12 - C16 (Aromatics)	1.460		1.4600
>C16 - C21 (Aromatics)	0.650	#	0.6500 #
>C21 - C35 (Aromatics)	0.0067	#	0.0067 #

NOTE:

#: Calculated concentrations exceeded pure component water solubility and hence water solubilities are listed as allowable groundwater concentrations at the POE.

Table 5-7
Tier 1 Default Dilution Attenuation Factors
in the Saturated Zone (DAF_{sat})

Distance from the edge of the mixing zone [ft]	DAF _{sat} [(mg/L)/(mg/L)]
0	1
50	1.31
100	3.11
150	6.23
200	10.6
250	16.3
300	23.2
350	31.3
400	40.8
450	51.4
500	63.4
600	91
700	124
800	161
900	204
1000	252

Note:

Calculated using Domenico's Model and the following assumptions:

- Infinite source
- No chemical biodegradation
- Source width of 49.2 feet (1500 cm)
- Source thickness of 6.6 feet (200 cm)

Table 5-8
Risk-Based Screening Levels for a Resident Child

CHEMICAL	SURFICIAL SOIL	SUB-SURFACE SOIL	GROUNDWATER
	Surficial Soil: Ingestion, Inhalation (Vapor Emissions and Particulates), and Dermal Contact	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions
	[mg/kg]	[mg/kg]	[mg/L]
ORGANICS			
Benzene	7.57E+00	2.55E-01	4.13E-01
Toluene	7.76E+02 *	1.25E+02	1.08E+02
Ethylbenzene	1.16E+03 *	1.16E+03 *	1.69E+02 #
Xylenes (mixed)	1.40E+03 *	5.04E+02	9.18E+01
Methyl-tert-butyl-ether (MTBE)	1.22E+04 *	1.44E+03	6.80E+03
Naphthalene	7.06E+02	1.64E+04	1.27E+01
TPH FRACTIONS			
TPH-GRO	1.49E+03 *	8.14E+02	4.30E+01
TPH-DRO	1.07E+03 *	9.60E+02 *	3.08E+01 #
TPH-ORO	8.38E+00 *	N/A	N/A
C5 - C6 (Aliphatics)	N/A	N/A	N/A
>C6 - C8 (Aliphatics)	2.31E+02 *	2.16E+02	5.40E+00 #
>C8 - C10 (Aliphatics)	1.38E+02 *	5.70E+01	2.41E-01
>C10 - C12 (Aliphatics)	8.56E+01 *	8.56E+01 *	3.40E-02 #
>C12 - C16 (Aliphatics)	3.81E+01 *	3.81E+01 *	7.60E-04 #
>C16 - C35 (Aliphatics)	8.20E+00 *	N/A	N/A
>C8 - C10 (Aromatics)	1.04E+03 *	4.55E+02	3.73E+01
>C10 - C12 (Aromatics)	6.31E+02 *	6.31E+02 *	2.50E+01 #
>C12 - C16 (Aromatics)	2.91E+02 *	2.91E+02 *	5.80E+00 #
>C16 - C21 (Aromatics)	1.03E+02 *	N/A	N/A
>C21 - C35 (Aromatics)	8.38E+00 *	N/A	N/A

NOTE:

* Calculated RBSLs exceeded saturated soil concentration and hence saturated soil concentrations are listed RBSLs.

Calculated RBSLs exceeded pure component water solubility and hence water solubilities are listed as RBSLs.

Soil concentrations are presented on a dry weight basis.

N/A: Not applicable

Table 5-9
Risk-Based Screening Levels for a Resident Adult

CHEMICAL	SURFICIAL SOIL	SUB-SURFACE SOIL	GROUNDWATER
	Surficial Soil: Ingestion, Inhalation (Vapor Emissions and Particulates), and Dermal Contact	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions
	[mg/kg]	[mg/kg]	[mg/L]
ORGANICS			
Benzene	6.32E+00	1.57E-01	2.54E-01
Toluene	7.76E+02 *	3.83E+02	3.33E+02
Ethylbenzene	1.16E+03 *	1.16E+03 *	1.69E+02 #
Xylenes (mixed)	1.40E+03 *	1.40E+03 *	1.98E+02 #
Methyl-tert-butyl-ether (MTBE)	1.22E+04 *	4.42E+03	2.09E+04
Naphthalene	2.85E+03	4.77E+04 *	3.10E+01 #
TPH FRACTIONS			
TPH-GRO	1.49E+03 *	1.49E+03 *	7.09E+01 #
TPH-DRO	1.07E+03 *	9.60E+02 *	3.08E+01 #
TPH-ORO	8.38E+00 *	N/A	N/A
C5 - C6 (Aliphatics)	N/A	N/A	N/A
>C6 - C8 (Aliphatics)	2.31E+02 *	2.31E+02 *	5.40E+00 #
>C8 - C10 (Aliphatics)	1.38E+02 *	1.38E+02 *	4.30E-01 #
>C10 - C12 (Aliphatics)	8.56E+01 *	8.56E+01 *	3.40E-02 #
>C12 - C16 (Aliphatics)	3.81E+01 *	3.81E+01 *	7.60E-04 #
>C16 - C35 (Aliphatics)	8.20E+00 *	N/A	N/A
>C8 - C10 (Aromatics)	1.04E+03 *	1.04E+03 *	6.50E+01 #
>C10 - C12 (Aromatics)	6.31E+02 *	6.31E+02 *	2.50E+01 #
>C12 - C16 (Aromatics)	2.91E+02 *	2.91E+02 *	5.80E+00 #
>C16 - C21 (Aromatics)	1.03E+02 *	N/A	N/A
>C21 - C35 (Aromatics)	8.38E+00 *	N/A	N/A

NOTE:

* Calculated RBSLs exceeded saturated soil concentration and hence saturated soil concentrations are listed RBSLs.

Calculated RBSLs exceeded pure component water solubility and hence water solubilities are listed as RBSLs.

Soil concentrations are presented on a dry weight basis.

N/A: Not applicable

Table 5-10
Risk-Based Screening Levels for a Commercial Worker

CHEMICAL	SURFICIAL SOIL	SUB-SURFACE SOIL		GROUNDWATER
	Surficial Soil: Ingestion, Inhalation (Vapor Emissions and Particulates), and Dermal Contact	Indoor Inhalation of Vapor Emissions		Indoor Inhalation of Vapor Emissions
	[mg/kg]	[mg/kg]		[mg/L]
ORGANICS				
Benzene	1.17E+01		4.92E-01	7.99E-01
Toluene	7.76E+02 *	*	7.76E+02 *	5.26E+02
Ethylbenzene	1.16E+03	*	1.16E+03	1.69E+02 #
Xylenes (mixed)	1.40E+03	*	1.40E+03	1.98E+02
Methyl-tert-butyl-ether (MTBE)	1.22E+04 *	*	1.16E+04	4.80E+04
Naphthalene	4.39E+03		4.77E+04 *	3.10E+01 #
TPH FRACTIONS				
TPH-GRO	1.49E+03	*	1.49E+03	6.55E+01 #
TPH-DRO	1.07E+03	*	9.60E+02 *	3.08E+01 #
TPH-ORO	8.38E+00	*	N/A	N/A
C5 - C6 (Aliphatics)	N/A		N/A	N/A
>C6 - C8 (Aliphatics)	2.31E+02	*	2.31E+02	5.40E+00 #
>C8 - C10 (Aliphatics)	1.38E+02	*	1.38E+02	4.30E-01 #
>C10 - C12 (Aliphatics)	8.56E+01	*	8.56E+01	3.40E-02 #
>C12 - C16 (Aliphatics)	3.81E+01	*	3.81E+01	7.60E-04
>C16 - C35 (Aliphatics)	8.20E+00	*	N/A	N/A
>C8 - C10 (Aromatics)	1.04E+03	*	1.04E+03	6.50E+01 #
>C10 - C12 (Aromatics)	6.31E+02	*	6.31E+02	2.50E+01
>C12 - C16 (Aromatics)	2.91E+02	*	2.91E+02	5.80E+00 #
>C16 - C21 (Aromatics)	1.03E+02	*	N/A	N/A
>C21 - C35 (Aromatics)	8.38E+00	*	N/A	N/A

NOTE:

* Calculated RBSLs exceeded saturated soil concentration and hence saturated soil concentrations are listed RBSLs.

Calculated RBSLs exceeded pure component water solubility and hence water solubilities are listed as RBSLs.

Soil concentrations are presented on a dry weight basis.

N/A: Not applicable

Table 5-11
Risk-Based Screening Levels for a Construction Worker

CHEMICAL	SOIL	
	Surficial Soil: Ingestion, Inhalation (Vapor Emissions and Particulates), and Dermal Contact [mg/kg]	
ORGANICS		
Benzene	2.43E+02	
Toluene	7.76E+02	*
Ethylbenzene	1.16E+03	*
Xylenes (mixed)	1.40E+03	*
Methyl-tert-butyl-ether (MTBE)	1.22E+04	*
Naphthalene	4.36E+03	
TPH FRACTIONS		
TPH-GRO	1.49E+03	*
TPH-DRO	1.07E+03	*
TPH-ORO	8.38E+00	*
C5 - C6 (Aliphatics)	N/A	
>C6 - C8 (Aliphatics)	2.31E+02	*
>C8 - C10 (Aliphatics)	1.38E+02	*
>C10 - C12 (Aliphatics)	8.56E+01	*
>C12 - C16 (Aliphatics)	3.81E+01	*
>C16 - C35 (Aliphatics)	8.20E+00	*
>C8 - C10 (Aromatics)	1.04E+03	*
>C10 - C12 (Aromatics)	6.31E+02	*
>C12 - C16 (Aromatics)	2.91E+02	*
>C16 - C21 (Aromatics)	1.03E+02	*
>C21 - C35 (Aromatics)	8.38E+00	*

NOTE:

* Calculated RBSLs exceeded saturated soil concentration and hence saturated soil concentrations are listed RBSLs.

Calculated RBSLs exceeded pure component water solubility and hence water solubilities are listed as RBSLs.

Soil concentrations are presented on a dry weight basis.

N/A: Not applicable

Table 5-12

Tier 1 RBSLs for Soil Concentrations (for Leaching to Groundwater) for Different Distances to the Groundwater Exposure Point

CHEMICALS	Water	TIER 1 RBTLs FOR SOIL CONCENTRATION AT THE SOURCE FOR DIFFERENT DISTANCES TO THE EXPOSURE POINT											
	Standard [†]	0 ft.	50 ft.	100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.	500 ft.	1000 ft.
	[mg/l]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
ORGANICS													
Benzene	5.00E-03	1.53E-02	2.00E-02	4.75E-02	9.52E-02	1.62E-01	2.49E-01	3.54E-01	4.79E-01	6.23E-01	7.86E-01	9.68E-01	3.85E+00
Toluene	1.00E+00	5.75E+00	7.52E+00	1.79E+01	3.58E+01	6.10E+01	9.35E+01	1.33E+02	1.80E+02	2.34E+02	2.96E+02	3.64E+02	7.76E+02 *
Ethylbenzene	7.00E-01	1.88E+01	2.46E+01	5.83E+01	1.17E+02	1.99E+02	3.06E+02	4.35E+02	5.89E+02	7.66E+02	9.66E+02	1.16E+03 *	1.16E+03 *
Xylenes (mixed)	1.00E+01	2.74E+02	3.59E+02	8.53E+02	1.40E+03 *	1.40E+03 *	1.40E+03 *	1.40E+03 *	1.40E+03 *	1.40E+03 *	1.40E+03 *	1.40E+03 *	1.40E+03 *
Methyl-tert-butyl-ether (MTBE)	2.00E-02	1.97E-02	2.58E-02	6.13E-02	1.23E-01	2.10E-01	3.21E-01	4.58E-01	6.19E-01	8.05E-01	1.02E+00	1.25E+00	4.97E+00
Naphthalene	7.30E-01	4.38E+03	5.73E+03	1.36E+04	2.73E+04	4.65E+04	4.77E+04 *	4.77E+04 *	4.77E+04 *	4.77E+04 *	4.77E+04 *	4.77E+04 *	4.77E+04 *
TPH FRACTIONS													
TPH-GRO	7.32E+00	5.45E+02	5.73E+02	7.36E+02	1.02E+03	1.42E+03	1.49E+03 *	1.49E+03 *	1.49E+03 *	1.49E+03 *	1.49E+03 *	1.49E+03 *	1.49E+03 *
TPH-DRO	3.57E+00	5.79E+02	6.28E+02	8.86E+02	1.07E+03 *	1.07E+03 *	1.07E+03 *	1.07E+03 *	1.07E+03 *	1.07E+03 *	1.07E+03 *	1.07E+03 *	1.07E+03 *
TPH-ORO	6.66E-03	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *
C5 - C6 (Aliphatics)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
>C6 - C8 (Aliphatics)	5.40E+00	2.31E+02 *	2.31E+02 *	2.31E+02 *	2.31E+02 *	2.31E+02 *	2.31E+02 *	2.31E+02 *	2.31E+02 *	2.31E+02 *	2.31E+02 *	2.31E+02 *	2.31E+02 *
>C8 - C10 (Aliphatics)	4.30E-01	1.38E+02 *	1.38E+02 *	1.38E+02 *	1.38E+02 *	1.38E+02 *	1.38E+02 *	1.38E+02 *	1.38E+02 *	1.38E+02 *	1.38E+02 *	1.38E+02 *	1.38E+02 *
>C10 - C12 (Aliphatics)	3.40E-02	8.56E+01 *	8.56E+01 *	8.56E+01 *	8.56E+01 *	8.56E+01 *	8.56E+01 *	8.56E+01 *	8.56E+01 *	8.56E+01 *	8.56E+01 *	8.56E+01 *	8.56E+01 *
>C12 - C16 (Aliphatics)	7.60E-04	3.81E+01 *	3.81E+01 *	3.81E+01 *	3.81E+01 *	3.81E+01 *	3.81E+01 *	3.81E+01 *	3.81E+01 *	3.81E+01 *	3.81E+01 *	3.81E+01 *	3.81E+01 *
>C16 - C35 (Aliphatics)	1.30E-06	8.20E+00 *	8.20E+00 *	8.20E+00 *	8.20E+00 *	8.20E+00 *	8.20E+00 *	8.20E+00 *	8.20E+00 *	8.20E+00 *	8.20E+00 *	8.20E+00 *	8.20E+00 *
>C8 - C10 (Aromatics)	1.46E+00	9.06E+01	1.19E+02	2.82E+02	5.64E+02	9.62E+02	1.04E+03 *	1.04E+03 *	1.04E+03 *	1.04E+03 *	1.04E+03 *	1.04E+03 *	1.04E+03 *
>C10 - C12 (Aromatics)	1.46E+00	1.44E+02	1.88E+02	4.46E+02	6.31E+02 *	6.31E+02 *	6.31E+02 *	6.31E+02 *	6.31E+02 *	6.31E+02 *	6.31E+02 *	6.31E+02 *	6.31E+02 *
>C12 - C16 (Aromatics)	1.46E+00	2.86E+02	2.91E+02 *	2.91E+02 *	2.91E+02 *	2.91E+02 *	2.91E+02 *	2.91E+02 *	2.91E+02 *	2.91E+02 *	2.91E+02 *	2.91E+02 *	2.91E+02 *
>C16 - C21 (Aromatics)	6.50E-01	1.03E+02 *	1.03E+02 *	1.03E+02 *	1.03E+02 *	1.03E+02 *	1.03E+02 *	1.03E+02 *	1.03E+02 *	1.03E+02 *	1.03E+02 *	1.03E+02 *	1.03E+02 *
>C21 - C35 (Aromatics)	6.66E-03	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *	8.38E+00 *

Note

* Calculated Tier 1 RBSLs for soil concentrations exceeded saturated soil concentration and hence saturated soil concentrations are listed Tier 1 RBSLs for soil concentrations protective of groundwater.

[†] MCL, Health Advisory, or Ingestion of water Tier 1 RBTL for a resident adult.

Soil concentrations are presented on a dry weight basis.

N/A: Not applicable